MATERIAL SAFETY DATA SHEET

1. SUBSTANCE AND SOURCE IDENTIFICATION

National Institute of Standards and Technology
Standard Reference Materials Program
100 Bureau Drive, Stop 2320
Gaithersburg, Maryland 20899-2320

SRM Number: 3149
MSDS Number: 3149
SRM Name: Selenium Standard Solution

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Description: This Standard Reference Material (SRM) is intended for use as a primary calibration standard for the quantitative determination of selenium. One unit of SRM 3149 consists of five 10 mL sealed borosilicate glass ampoules of an acidified aqueous solution prepared gravimetrically to contain a known mass fraction of selenium. The solution contains nitric acid at a volume fraction of approximately 10 %.

Material Name: Selenium Standard Solution

Other Designations:

Selenium: Se; elemental selenium
Selenic Acid: Selenic acid hydrate; selenic acid monohydrate
Nitric Acid: Aqua fortis; hydronitrate; azotic acid; engraver's acid.

2. COMPOSITION AND INFORMATION ON HAZARDOUS INGREDIENTS

Component	CAS Registry	EC Number (EINECS)	Concentration (%)
Nitric Acid	7697-37-2	231-714-2	10
Selenic Acid	7783-08-6	231-979-4	1.8
Selenium	7782-49-2	231-957-4	1

EC Classification, R/S Phrases: Refer to Section 15, Regulatory Information.

3. HAZARDS IDENTIFICATION

NFPA Ratings (Scale 0-4): Health = 4 Fire = 0 Reactivity = 2

Major Health Hazards: Nitric acid and selenic acid can both cause severe or fatal burns if inhaled, swallowed, or absorbed through the skin. Elemental selenium can irritate the respiratory tract, GI tract, skin, and eyes; ingestion may damage the heart, liver, and other organs.

Physical Hazards: Glass container may break or shatter.

Potential Health Effects

Inhalation: Nitric acid and selenic acid can both damage the mucous membranes and respiratory tract, causing spasm, inflammation of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Symptoms may include burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea, and vomiting. Teeth may also be damaged. Inhalation of selenium dust (not present in this mixture) can cause severe irritation, coughing, and headache.

Skin Contact: Nitric acid and selenic acid can both cause severe skin burns. Effects of acid burns may be delayed. Skin contact with selenium has caused skin irritation and dermatitis.

Eye Contact: Nitric acid and selenic acid can both cause severe eye irritation, corneal burns, permanent eye damage, or blindness. Contact with selenium dust, or airborne particulates at high concentrations, can cause severe eye irritation or conjunctivitis.

Ingestion: Nitric acid and selenic acid can both cause severe burns and damage to the GI tract. Elemental selenium is poorly absorbed from the GI tract, but ingestion may cause severe irritation of the GI tract, with abdominal pain, nausea, vomiting, diarrhea, and a metallic taste in the mouth. Repeated or long-term exposure may cause anemia or birth defects, and may also damage the heart, liver, kidneys, or reproductive system.

Medical Conditions Aggravated by Exposure: Pre-existing disorders affecting the eyes, skin, respiratory tract, kidneys, liver, nervous system, cardiovascular system, blood, or other target organs.

Listed as a Carcinogen/ Potential Carcinogen:

	Yes	No
In the National Toxicology Program (NTP) Report on Carcinogens		X
In the International Agency for Research on Cancer (IARC) Monographs		X
By the Occupational Safety and Health Administration (OSHA)		X

4. FIRST AID MEASURES

Inhalation: Move the person to fresh air immediately. If not breathing, qualified personnel may start CPR or give oxygen if necessary. Get medical aid at once, and bring the container or label.

Skin Contact: Remove contaminated clothing and shoes. Flush affected skin with water for at least 15 minutes, then wash thoroughly with soap and water. If burns are severe or if skin irritation persists, get medical aid and bring the container or label. Wash contaminated clothing before reusing.

Eye Contact: Remove contact lenses (if any). Do not allow victim to rub eyes or keep eyes closed. Flush eyes with large amounts of running water for at least 30 minutes, keeping eyelids open and raising lids to remove all chemical. Get medical aid at once, and bring the container or label.

Ingestion: Contact a poison control center immediately for instructions. Wash out mouth with water, but do not induce vomiting. Get medical aid at once, and bring the container or label.

Note to Physician (Nitric Acid): Wash affected skin with 5% solution of sodium bicarbonate ($NaHCO_2$). Activated charcoal is of no value. Do not give bicarbonate to neutralize the material.

5. FIRE FIGHTING MEASURES

Fire and Explosion Hazards: Nitric acid is a powerful oxidizing agent that can react with combustible materials to cause fires. Selenic acid and selenium are negligible fire hazards. No data are available for the mixture, and its behavior may differ from that of the individual components.

Extinguishing Media: Use extinguishing media appropriate to the surrounding fire: water spray, dry chemical, carbon dioxide, or foam. Use a water spray to dilute nitric acid and to absorb liberated oxides of nitrogen. (These guidelines apply to the mixture; when the components are considered separately, different precautions may apply.)

Fire Fighting: Avoid inhalation of material or combustion byproducts. Wear full protective clothing and NIOSH-approved self-contained breathing apparatus (SCBA).

Flash Point (°C): N/A

Autoignition (°C): N/A

Lower Explosive Limit (LEL): N/A

Upper Explosive Limit (UEL): N/A

Flammability Class (OSHA): N/A

6. ACCIDENTAL RELEASE MEASURES

Occupational Release: Notify safety personnel of spills. Surfaces contaminated with this material should be covered with soda ash or sodium bicarbonate to neutralize the acid. Place the neutralized material into containers suitable for eventual disposal, reclamation, or destruction.

Disposal: Refer to Section 13, Disposal Considerations.

7. HANDLING AND STORAGE

Storage: Store unopened containers of this material in a dry place with acid-resistant flooring at room temperature. Protect from physical damage, water, humidity, heat, direct sunlight, and incompatible materials.

Safe Handling Precautions: Wear gloves and chemical safety goggles (Section 8). Engineering controls should maintain airborne concentrations below TLV (Section 8).

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

Nitric Acid:

ACGIH TLV-TWA: 2 ppm or 5 mg/m^3
OSHA TLV-TWA: 2 ppm or 5 mg/m^3
UK WEL: 5.2 mg/m^3

Selenic Acid

ACGIH TLV-TWA: 0.2 mg/m^3
OSHA TLV-TWA: 0.2 mg/m^3
UK WEL: 0.1 mg/m^3

Selenium

ACGIH TLV-TWA: 0.2 mg/m^3
OSHA TLV-TWA: 0.2 mg/m^3
UK WEL: 0.1 mg/m^3

Ventilation: Use local or general exhaust to keep employee exposures below limits. Local exhaust ventilation is preferred because it can control contaminant emissions at the source, preventing dispersion into the general work area. Refer to the ACGIH document *Industrial Ventilation, a Manual of Recommended Practices*.

Respirator: If necessary, refer to the NIOSH document *Guide to the Selection and Use of Particulate Respirators Certified under 42 CFR 84* for selection and use of respirators certified by NIOSH.

Eye Protection: Use chemical safety goggles where dusting or splashing of solutions may occur. See OSHA standard (29 CFR 1910.133) or European Standard EN166. The employer should provide an emergency eye wash fountain and safety shower in the immediate work area.

Personal Protection: Wear appropriate gloves and protective clothing to prevent contact with skin.

9. PHYSICAL AND CHEMICAL PROPERTIES

Nitric Acid	Selenic Acid	Selenium
Appearance and Odor: Colorless to slightly yellow liquid, darkens to brown upon aging and exposure to light; irritating, pungent odor.	**Appearance and Odor:** Colorless to white deliquescent crystals; hygroscopic	**Appearance and Odor:** Red, gray, or black solid; odorless
Relative Molecular Weight: 63.02	**Relative Molecular Weight:** 144.98 (anhydrous)	**Relative Molecular Weight:** 78.96
Molecular Formula: HNO_3	**Molecular Formula:** H_2SeO_4	**Molecular Formula:** Se
Specific Gravity: 1.0543 (10%)	**Specific Gravity:** 3.0	**Specific Gravity:** 4.81
Solvent Solubility: Decomposes in alcohol	**Solvent Solubility:** Soluble in sulfuric acid	**Solvent Solubility:** Soluble in sulfuric acid, chloroform, methylene iodide, benzene, quinoline, nitric acid, ether, and alkali solutions
Water Solubility: Soluble	**Water Solubility:** Soluble	**Water Solubility:** Insoluble
Boiling Point (ºC): 86 (187°F)	**Boiling Point (ºC):** 260 (500ºF), decomposes	**Boiling Point (ºC):** 685 (1265ºF)
Vapor Density (Air=1): 2.17	**Vapor Density (Air=1):** N/A	**Vapor Density (Air=1):** N/A
pH: 1.0 (0.1M solution)	**pH:** 1.72 (0.05M solution)	**pH:** N/A

NOTE: The physical and chemical data provided are for the pure components. Physical and chemical data for this solution do not exist. The actual behavior of the solution may differ from the individual components.

10. STABILITY AND REACTIVITY

Stability: __X__ Stable _____Unstable

Stable at normal temperatures and pressure.

Conditions to Avoid: Heat, incompatible materials.

Incompatible Materials:

Nitric Acid: Incompatible with numerous materials including organic materials, plastics, rubber, chlorine, and metal ferrocyanide.

Hazardous Decomposition: Thermal decomposition of this material may produce nitrogen oxides and selenium oxides.

Hazardous Polymerization: _____ Will Occur __X__ Will Not Occur

11. TOXICOLOGICAL INFORMATION

Route of Entry: __X__ Inhalation __X__ Skin __X__ Ingestion

Nitric Acid:

Human, oral: LD_{Lo} = 430 mg/kg
Rat, oral: LD_{50} > 90 mg/kg
Rat, inhalation: LC_{50} (4 hrs) = 130 mg/m^3

Selenic Acid:

Rat, oral: LD_{50} = 1.6 mg/kg [as sodium selenate]
Human, lowest oral toxic dose: 22 mg/kg

Selenium:

Rat, oral: LD_{50} = 6700 mg/kg
Human, LOAEL: 0.023 mg/kg/day
Human, NOAEL: 0.015 mg/kg/day

Target Organ(s): Eyes, skin, respiratory tract, kidneys, liver, nervous system, cardiovascular system, blood.

Mutagen/Teratogen: Nitric acid has caused birth defects in animals under experimental conditions, and has been investigated as a possible mutagen. Selenium and its compounds may also cause birth defects. RTECS lists selenic acid as a mutagen.

Health Effects: See Section 3.

12. ECOLOGICAL INFORMATION

Nitric Acid, Ecotoxicity Data:

Green shore crab (*Carcinus maenas*): LC_{50} (48 hrs) = 180,000 µg/L
Starfish (*Asterias rubens*): LC_{50} (48 hrs) = 100,000 to 330,000 µg/L
Hooknose (*Agonus cataphractus*): LC_{50} (48 hrs) = 100,000 to 330,000 µg/L
Brook trout (*Salvelinus fontinalis*): NR-LETH = 1,562 µg/L
Cockle (*Cerastoderma edule*): LC_{50} (48 hrs) = 330,000 to 1,000,000 µg/L

Selenic Acid: See data for Selenium

Selenium (as selenate, selenite, or metal salts):

Eastern narrow-mouthed toad (*Gastrophryne carolinensis*): LC_{50} = 90 µg/L
Sheepshead minnow (*Cyprinodon variegatus*): LC_{50} (96 hrs) = 6,700 µg/L
Rainbow trout (*Oncorhynchus mykiss*): LOEC (384 hrs) = 3,100 µg/L
Water flea (*Daphnia magna*): LC_{50} (48 hrs) = 9,340 µg/L

Environmental Summary: This mixture is expected to be toxic to aquatic organisms. Do not release to the environment.

13. DISPOSAL CONSIDERATIONS

Waste Disposal: One or more components of this mixture are classified as RCRA hazardous waste. Dispose of container and unused contents in accordance with federal, state, and local requirements for acid waste, which vary according to location. Decontaminate containers before recycling. Processing, use, or contamination of this product may change the waste management options.

14. TRANSPORTATION INFORMATION

U.S. DOT and IATA: Nitric Acid Solution, Hazard Class 8, UN2031, Packing Group II

15. REGULATORY INFORMATION

U.S. REGULATIONS

CERCLA Sections 102a/103 (40 CFR 302.4):

Nitric Acid: RQ = 1000 lbs.
Selenic Acid: No RQ assigned (N725, Selenium Compounds)
Selenium: RQ = 100 lbs.

SARA Title III Section 302: Nitric acid is regulated.

SARA Title III Section 304: Nitric acid is regulated.

SARA Title III Section 313: All three components are regulated.

OSHA Process Safety (29 CFR 1910.119): Not regulated

SARA Title III Sections 311/312 Hazardous Categories (40 CFR 370.21):

ACUTE:	Yes
CHRONIC:	Yes
FIRE:	No
REACTIVE:	Yes
SUDDEN RELEASE:	No

STATE REGULATIONS

California Proposition 65: No components are regulated.

CANADIAN REGULATIONS

WHMIS Classification:

Nitric Acid: C (oxidizing material), D1A (very toxic material), E (corrosive material)
Selenic Acid: D1A (very toxic material), E (corrosive material)
Selenium: D1A (very toxic material)

WHMIS Ingredient Disclosure List:

Nitric Acid 1%
Selenic Acid 1% (Selenium Compounds, n.o.s.)
Selenium 0.1%

CEPA Domestic Substances List (DSL): Nitric acid and selenium are regulated.

CEPA Non-Domestic Substances List (NDSL): Selenic acid is regulated.

EUROPEAN REGULATIONS

EU/EC Classification:

Nitric Acid: O (Oxidizer), C (Corrosive)
Selenic Acid: C (Corrosive); not classified in Annex I of Directive 67/548/EEC; not on a priority list.
Selenium: T (Toxic)

Risk Phrases (mixture):

R23/25 (toxic by inhalation and if swallowed)
R33 (danger of cumulative effects)
R34 (causes burns)
R36/37/38 (irritating to eyes, respiratory system and skin)
R53 (may cause long-term adverse effects in the aquatic environment)

Safety Phrases (mixture):

S20/21 (when using, do not eat, drink or smoke)
S28 (wash after contact with skin)
S45 (in case of accident or illness, see doctor; show label)
S60 (dispose of this material and its container as hazardous waste)

NATIONAL INVENTORY STATUS

U.S. Inventory (TSCA): All components are listed.

TSCA 12(b), Export Notification: No components are listed.

16. OTHER INFORMATION

Sources:

PAN Pesticide Database: Nitric Acid.

Pan Pesticide Database: Selenium and Selenium Compounds.

U.S. National Institute for Occupational Safety and Health, *NIOSH Pocket Guide to Chemical Hazards*, September 2005 edition. DHHS (NIOSH) Publication No. 2005-151.

Disclaimer: Physical and chemical data contained in this MSDS are provided only for use as a guide in assessing the hazardous nature of the material. The MSDS was prepared carefully, using current references; however, NIST does not certify the data in the MSDS. The certified values for this material are given in the NIST Certificate of Analysis.